Jasper A. Vrugt

CONTACT INFORMATION

Earth and Environmental Sciences Division (EES-16) — *Voice:* (505) 664-1712
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RESEARCH INTERESTS

I am interested in developing and applying optimization and uncertainty analysis methods using evolutionary principles, Bayesian statistics, sequential data assimilation, and high performance computing to explore complex model parameter and state spaces. I particularly design methods to better analyze the mismatch between model predictions and observations (error residuals) for structural model errors, with the ultimate goal to improve our theory and understanding of the functioning of environmental systems. Most of my work is within the context of hydrology (surface and subsurface), soil physics and applied mathematics, but applications span the general field of earth and environmental sciences, including (but not limited to) ecology, hydrometeorology, weather forecasting, soil and surface water chemistry.

EDUCATION

Ph.D., University of Amsterdam, Amsterdam, The Netherlands, 2004, *Cum Laude*
Dissertation: *Towards Improved Treatment of Parameter Uncertainty in Hydrologic Modeling*
Advisors: Willem Bouten and Koos Verstraten

M.S., University of Amsterdam, Amsterdam, The Netherlands, 1999, *Cum Laude*

EXPERIENCE

Los Alamos National Laboratory

J. Robert Oppenheimer (JRO) Distinguished Postdoctoral Fellow	12/06 - present
Director's Funded Postdoctoral Fellow	3/05 - 11/06

HONORS AND AWARDS

Early Career Award in Soil Physics, Soil Science Society of America	2007
Hydrology Prize 2004 - 2006, Dutch Hydrological Society (NHV)	2007

PROFESSIONAL ACTIVITIES

Editorial

Associate Editor of Hydrology and Earth Systems Sciences	2008 - present
Associate Editor of Vadose Zone Journal	2008 - present
Guest-editor for special issue on Parameter Identification and Uncertainty Assessment in the Unsaturated Zone, *Vadose Zone Journal*, 5, 915 - 989	2006
Reviewing papers for peer-reviewed international journals. These journals include: *Advances in Water Resources, Environmental Modelling and Software, IEEE Transactions on Evolutionary Computation, Geophysical Research Letters, Hydrologic Processes, Hydrology Research, Hydrological Sciences Journal, Hydrology and Earth Systems Sciences, Journal of Hydrology, Radio Science, Scientia Iranica, Soil Science Society of America Journal, Vadose Zone Journal, Water Resources Research*, and *Water Resources Management*	2002 - present
Proposal reviewer for National Science Foundations of Belgium, the Netherlands, United Kingdom, and United States	2006 - present

Teaching Experience

Invited lecturer for a weekly course on *Model Calibration in the Earth Sciences*, Leuven, Belgium, August 4-8. I taught four lectures of about 3 hours to 35 graduate students from different European countries and developed various exercises in MATLAB to support the lectures during afternoon computer sessions.	2008
Invited lecturer at graduate course on *Vadose Zone Modeling*, University of California, Davis, June 7-8. Two hour lecture on parameter estimation in vadose zone hydrology.	2007
Invited lecturer at International Summer School on Atmospheric and Oceanic Sciences (ISSAOS), L'Aquila, Italy, August 29-September 2. Two lectures on parameter estimation and data assimilation in environmental modeling for international graduate students.	2005
Graduate Teaching Assistant, University of Amsterdam, Netherlands. Ten lectures on soil physics for undergraduates in Physical Geography and Soil Science. Prepared lectures for lab session exercises, and graded laboratory assignments, homework and final papers.	1/00 - 4/00
Teaching Assistant, University of Amsterdam, Netherlands. Ten lectures on soil physics for undergraduates in Physical Geography. Prepared lectures for lab session exercises, graded laboratory assignments, homework and final papers.	1/99-4/99

External PhD examinator

Reza Entezarolmahdi (University of Trento, Italy)	2006
Ying Jang (Institute of Aquatic Science and Technology, Switzerland)	2006
Three PhD-students (Colorado School of Mines, USA)	2008 - 2010

Grants

Subsurface Transport Parameter Estimation with Multiscale, Multiobjective Optimization; Principal Investigator (PI): A. Wolfsberg, Co-PIs: Z. Dai, Z. Lu, P. Reimus, and **J.A. Vrugt**; Amount: $645,000	LDRD, 2006
Creating a Mathematical Foundation for High-dimensional Search and Optimization Algorithms to Solve Nonlinear Models; PI: **J.A. Vrugt**, Co-PIs: B.A. Robinson, and J.M. Hyman; Amount: $1,000,000	LDRD, 2006
Multilevel Adaptive Sampling for Multiscale Inverse Problems; D. Moulton, Co-PIs: D. Higdon, C. Fox, and **J.A. Vrugt**; Amount: $900,000	LDRD, 2007
Development of User-Friendly GUI Interfaces for the AMALGAM Optimization Suite; PI: **J.A. Vrugt**, Co-PIs: B.A. Robinson, and T. Marks; Amount: $50,000	TT, 2007

Conferences and Symposia Activities

1. Chair and organizer of the European Geophysical Union session on *Model Calibration and Uncertainty Assessment of Unsaturated Flow and Transport Processes Across Spatial Scales*, Nice, France, 2004.
2. Chair and organizer of the European Geophysical Union session on *Effective Processes and Parameter Identification in the Unsaturated Zone*, Vienna, Austria, 2005.
3. Co-chair and co-convener European Geophysical Union session on *Quantification of Structural Error, Parameter Estimation and Uncertainty Assessment in Groundwater and Hydrological Catchment Modeling*, Vienna, Austria, 2005.
4. Chair and organizer of the American Geophysical Union Fall meeting session on *Calibration and Uncertainty Assessment of Spatially Distributed Hydrologic Models*, San Francisco, 2005.
5. Chair and organizer of the European Geophysical Union session on *Effective processes and parameter identification in the unsaturated zone*, Vienna, Austria, 2006.

6. Chair and organizer of the European Geophysical Union session on *Advances in Uncertainty Assessment of Hydrologic Models*, Vienna, Austria, 2006.
7. Chair and organizer of the workshop *Advances in Parameter Estimation in Computational-Science: Strategies, Concepts, and Applications* at the International Conference on Computational Science 2006 (ICCS 2006), Reading, UK, 2006.
8. Chair and organizer of the American Geophysical Union session on *Improved Hydrologic Modeling Through Ensemble Forecasting: Strategies, Concepts, and Applications*, at Western Pacific Geophysics Meeting, Beijing, China, 2006.
9. Chair and co-organizer of the American Geophysical Union Fall meeting session on *Calibration and Uncertainty Assessment of Spatially Distributed Hydrologic Models, Methods, Applications and Strategies*, San Francisco, 2006.
10. Co-chair and organizer of the European Geophysical Union session on *Calibration of Spatially Distributed Models*, Vienna, Austria, 2007.
11. Co-chair of the AAPG Hedberg Research Conference session on *Data Quality, Inversion and Uncertainty Estimation*, The Hague, The Netherlands, 2007.
12. Co-chair and organizer of the American Geophysical Union Fall meeting session on *Parameter Estimation in Hydrology: Theoretical Developments and Applications*, San Francisco, 2007.
13. Co-chair and organizer of the American Geophysical Union Fall meeting session on *Advancing Data Assimilation and Uncertainty Assessment for Improved Hydrologic Predictions*, San Francisco, 2007.
14. Chair and organizer (by invitation) of the Computational Methods in Water Resources (CMWR) meeting session on *Ensemble Forecasting in Environmental Modeling*, San Francisco, 2008.
15. Chair and organizer of the European Geophysical Union session on *Reconciling Theory, Simulation, and Observations in Subsurface Flow and Transport Modeling*, Vienna, Austria, 2008.
16. Chair and organizer of the Soil Science Society of America (SSSA) Symposium on *Measurement and Modeling of Flow and Transport Processes in the Unsaturated Zone*, in honor of the retirement of Dr. Jacob Dane, Houston, 2008.
17. Co-chair and co-organizer of the American Geophysical Union Fall meeting session on *Joint Inversion Methods in Hydrogeophysics*, San Francisco, 2008.

Publications

1. **J.A. Vrugt**, A.H. Weerts, and W. Bouten, Information content of data for identifying soil hydraulic parameters from outflow experiments, *Soil Science Society of America Journal*, 65, 19-27, 2001.
2. **J.A. Vrugt**, J.W. Hopmans, and J. Simunek, Calibration of a two-dimensional root water uptake model, *Soil Science Society of America Journal*, 65, 1027-1037, 2001.
3. **J.A. Vrugt**, M.T. van Wijk, J.W. Hopmans, and J. Simunek, One, two, and three-dimensional root water uptake functions for transient modeling, *Water Resources Research*, 37 (10), 2457-2470, 2001.
4. **J.A. Vrugt**, W. Bouten, S.C. Dekker, and P.A.D. Musters, Transpiration dynamics of an Austrian Pine stand and its forest floor: identifying controlling conditions using artificial neural networks, *Advances in Water Resources*, 25, 293-303, 2002.
5. **J.A. Vrugt**, and W. Bouten, Validity of first-order approximations to describe parameter uncertainty in soil hydrologic models, *Soil Science Society of America Journal*, 66 (6), 1740-1752, 2002.
6. **J.A. Vrugt**, W. Bouten, H.V. Gupta, and S. Sorooshian, Toward improved identifiability of hydrologic model parameters: The information content of experimental data, *Water Resources Research*, 38 (12), art. no. 1312, doi:10.1029/2001WR001118, 2002.

7. K.G.J. Nierop, B. Jansen, **J.A. Vrugt**, and J.M. Verstraten, Copper complexation by dissolved organic matter and uncertainty assessment of their stability constants, *Chemosphere*, 49 (10), 1191-1200, 2002.
8. **J.A. Vrugt**, H.V. Gupta, W. Bouten, and S. Sorooshian, A Shuffled Complex Evolution Metropolis algorithm for optimization and uncertainty assessment of hydrologic model parameters, *Water Resources Research*, 39 (8), art. No. 1201, doi:10.1029/2002WR001642, 2003.
9. **J.A. Vrugt**, H.V. Gupta, L.A. Bastidas, W. Bouten, and S. Sorooshian, Effective and efficient algorithm for multi-objective optimization of hydrologic models, *Water Resources Research*, 39 (8), art. No. 1214, doi:10.1029/2002WR001746, 2003.
10. **J.A. Vrugt**, S.C. Dekker, and W. Bouten, Identification of rainfall interception model parameters from measurements of throughfall and forest canopy storage, *Water Resources Research*, 39 (9), art. No. 1251, doi:10.1029/2003WR002013, 2003.
11. **J.A. Vrugt**, W. Bouten, H.V. Gupta, and J.W. Hopmans, Toward improved identifiability of soil hydraulic parameters: On the selection of a suitable parametric model, *Vadose Zone Journal*, 2, 98-113, 2003.
12. J.A. Huisman, W. Bouten, **J.A. Vrugt**, and P.A. Ferré, Accuracy of frequency domain analysis scenarios for the determination of complex dielectric permittivity, *Water Resources Research*, W02401, doi:10.1029/2002WR001601, 2004.
13. B. Jansen, K.G.J. Nierop, **J.A. Vrugt**, and J.M. Verstraten, (Un)certainty of overall binding constants of Al with dissolved organic matter determined by the Scatchard approach, *Water Research*, 38, 1270-1280, 2004.
14. **J.A. Vrugt**, G.H. Schoups, J.W. Hopmans, C.H. Young, W. Wallender, T. Harter, and W. Bouten, Inverse modeling of large scale spatially distributed vadose zone properties using global optimization, *Water Resources Research*, 40(6), W06503, doi:10.1029/2003WR002706, 2004.
15. T.J. Heimovaara, J.A. Huisman, **J.A. Vrugt**, and W. Bouten, Obtaining the spatial distribution of water content along a TDR probe using the SCEM-UA Bayesian inverse modeling scheme, *Vadose Zone Journal*, 3, 1128-1145, 2004.
16. K.J. Raat, **J.A. Vrugt**, W. Bouten, and A. Tietema, Towards reduced uncertainty in nitrogen catchment modeling: quantifying the effect of field observation uncertainty on model calibration, *Hydrology and Earth Systems Sciences*, 8(4), 751-763, 2004.
17. **J.A. Vrugt**, C.G.H. Diks, W. Bouten, H.V. Gupta, and J.M. Verstraten, Improved treatment of uncertainty in hydrologic modeling: Combining the strengths of global optimization and data assimilation, *Water Resources Research*, 41(1), W01017, doi:10.1029/2004WR003059, 2005.
18. **J.A. Vrugt**, B.A. Robinson, and V.V. Vesselinov, Improved inverse modeling of flow and transport in subsurface media: Combined parameter and state estimation, *Geophysical Research Letters*, 32, L18408, doi:10.1029/2005GL023940, 2005.
19. G.H. Schoups, J.W. Hopmans, C.A. Young, **J.A. Vrugt**, and W.W. Wallender, Sustainability of irrigated agriculture in the San Joaquin Valley, California, *Proceedings of the National Academy of Sciences of the United States of America*, 102 (43), 15352 - 15356, doi:10.1073/pnas.0507723102, 2005.

    This paper also features as Editor's Choice in Science, Science, 310, 593, 2005.
20. G.H. Schoups, J.W. Hopmans, C.A. Young, **J.A. Vrugt**, and W.W. Wallender, Multi-objective optimization of a regional spatially-distributed subsurface waterflow model, *Journal of Hydrology*, 20 - 48, 311(1-4), doi:10.1016/j.jhydrol.2005.01.001, 2005.
21. M.P. Clark, and **J.A. Vrugt**, Unraveling uncertainties in hydrologic model calibration: Addressing the problem of compensatory parameters, *Geophysical Research Letters*, 33(6), L06406, doi:10.1029/2005GL025604, 2006.

22. **J.A. Vrugt**, H.V. Gupta, B. Ó Nualláin, and W. Bouten, Real-time data assimilation for operational ensemble streamflow forecasting, *Journal of Hydrometeorology*, 7(3), 548 - 565, doi:10.1175/JHM504.1, 2006.

23. **J.A. Vrugt**, H.V. Gupta, S. Sorooshian, T. Wagener, and W. Bouten, Application of stochastic parameter optimization to the Sacramento soil moisture accounting model, *Journal of Hydrology*, 325(1-4), 288 - 307, doi:10.1016/j.jhydrol.2005.10.041, 2006.

24. **J.A. Vrugt**, B. Ó Nualláin, B.A. Robinson, W. Bouten, S.C. Dekker, and P.M.A. Sloot, Application of parallel computing to stochastic parameter estimation in environmental models, *Computers & Geosciences*, 32(8), 1139 - 1155, doi:10.1016/j.cageo.2005.10.015, 2006.

25. **J.A. Vrugt**, and Shlomo P. Neuman, Introduction to special section on parameter estimation and uncertainty estimation in the unsaturated zone, *Vadose Zone Journal*, 5, 915 - 916, doi:10.2136/vzj2006.0098, 2006.

26. **J.A. Vrugt**, M.P. Clark, C.G.H. Diks, Q. Duan, and B.A. Robinson, Multi-objective calibration of forecast ensembles using Bayesian Model Averaging, *Geophysical Research Letters*, 33, L19817, doi:10.1029/2006GL027126, 2006.

27. L. Feyen, **J.A. Vrugt**, B. Ó Nualláin, J. van der Knijff, and A. de Roo, Parameter optimization and uncertainty assessment for large-scale streamflow forecasting, *Journal of Hydrology*, 332, 276-289, 2007.

28. **J.A. Vrugt**, and B.A. Robinson, Treatment of uncertainty using ensemble methods: Comparison of sequential data assimilation and Bayesian model averaging, *Water Resources Research*, 43, W01411, doi:10.1029/2005WR004838, 2007.

29. **J.A. Vrugt**, and B.A. Robinson, Improved evolutionary optimization from genetically adaptive multimethod search, *Proceedings of the National Academy of Sciences of the United States of America*, 104, 708 - 711, doi:10.1073/pnas.0610471104, 2007.

30. **J.A. Vrugt**, J. van Belle, and W. Bouten, Pareto front analysis of flight time and energy use in long distance bird migration, *Journal of Avian Biology*, 38, 432 - 442, doi:10.1111/j.2007.0908-8857.03909, 2007. See also: http://openwetware.org/wiki/Optimality_In_Biology

31. J. Koller, Y. Chen, G. D. Reeves, R. H. W. Friedel, T. E. Cayton, and **J.A. Vrugt**, Identifying the radiation belt source region by data assimilation, *Journal of Geophysical Research - Space Physics*, 112, A06244, doi:10.1029/2006JA012196, 2007.

32. **J.A. Vrugt**, Comment on How effective and efficient are multiobjective evolutionary algorithms at hydrologic model calibration? *Hydrology and Earth System Sciences*, 11, 1435 - 1436, 2007.

33. P. Tittonell, M.T. van Wijk, M.C. Rufino, **J.A. Vrugt**, and K.E. Giller, Analyzing trade-offs in resource and labor allocation by smallholder African farmers using inverse modeling techniques, *Agricultural Systems*, 95, 76-95, doi:10.1016/j.agsy.2007.04.002, 2007.

34. T. Wöhling, **J.A. Vrugt**, and G.F. Barkle, Comparison of three multiobjective optimization algorithms for inverse modeling of vadose zone hydraulic properties, *Soil Science Society of America Journal*, 72, 305-319, doi:10.2136/sssaj2007.0176, 2008.

35. R.S. Blasone, **J.A. Vrugt**, H. Madsen, D. Rosbjerg, G.A. Zyvoloski, and B.A. Robinson, Generalized likelihood uncertainty estimation (GLUE) using adaptive Markov Chain Monte Carlo sampling, *Advances in Water Resources*, 31, 630-648, doi:10.1016/j.advwatres.2007.12.003, 2008.

36. L. Feyen, M. Khalas, and **J.A. Vrugt**, Semi-distributed parameter optimization and uncertainty assessment for large-scale streamflow simulation using global optimization, *Hydrological Sciences Journal*, 53(2), 293-208, 2008.

37. Harp, D.R., Z. Dai, A.V. Wolfsberg, **J.A. Vrugt**, B.A. Robinson, and V.V. Vesselinov, Aquifer structure identification using stochastic inversion, *Geophysical Research Letters*, 35, L08404, doi:10.1029/2008GL033585, 2008.

38. **J.A. Vrugt**, P.H. Stauffer, T. Wöhling, B.A. Robinson, and V.V. Vesselinov, Inverse modeling of subsurface flow and transport properties: A review with new developments, *Vadose Zone Journal*, 7(2), 843-864, doi:10.2136/vzj2007.0078, 2008.
39. M.P. Clark, A.G. Slater, D.E. Rupp, R.A. Woods, **J.A. Vrugt**, H. Gupta, T. Wagener, and L. Hay, Framework for understanding structural errors (FUSE): A modular framework to diagnose differences between hydrological models, *Water Resources Research*, 44, W00B02, doi:10.1029/2007WR006735, 2008.
40. H. Vereecken, J.A. Huisman, H. Bogena, J. Vanderborght, **J.A. Vrugt**, and J.W. Hopmans, On the value of soil moisture measurements in vadose zone hydrology: A review, *Water Resources Research*, 44, W00D06, doi:10.1029/2008WR006829, 2008.
41. **J.A. Vrugt**, C.G.H. Diks, and M.P. Clark, Ensemble Bayesian model averaging using Markov chain Monte Carlo sampling, *Environmental Fluid Mechanics*, 8(5-6), 579-595, doi:10.1007/s10652-008-9106-3, 2008.
42. C.J.F. ter Braak, and **J.A. Vrugt**, Differential evolution Markov chain with snooker updater and fewer chains, *Statistics and Computing*, 18(4), 435-446, doi:10.1007/s11222-008-9104-9, 2008.
43. **J.A. Vrugt**, C.J.F. ter Braak, M.P. Clark, J.M. Hyman, and B.A. Robinson, Treatment of input uncertainty in hydrologic modeling: Doing hydrology backward with Markov chain Monte Carlo simulation, *Water Resources Research*, 44, W00B09, doi:10.1029/2007WR006720, 2008.
44. T. Wöhling, and **J.A. Vrugt**, Combining multi-objective optimization and Bayesian model averaging to calibrate forecast ensembles of soil hydraulic models, *Water Resources Research*, 44, W12432, doi:10.1029/2008WR007154, 2008.
45. A. Behrangi, B. Khakbaz, **J.A. Vrugt**, Q. Duan, and S. Sorooshian, Comment on Dynamically dimensioned search algorithm for computationally efficient watershed model calibration, *Water Resources Research*, 44, W12603, doi:10.1029/2007WR006429, 2008.
46. **J.A. Vrugt**, C.J.F. ter Braak, H.V. Gupta, and B.A. Robinson, Equifinality of formal (DREAM) and informal (GLUE) Bayesian approaches in hydrologic modeling?, *Stochastic Environmental Research and Risk Assessment*, 1-16, doi:10.1007/s00477-008-0274-y, 2009, In Press.
47. **J.A. Vrugt**, C.J.F. ter Braak, H.V. Gupta, and B.A. Robinson, Reply to comment by Keith Beven on Equifinality of formal (DREAM) and informal (GLUE) Bayesian approaches in hydrologic modeling?, *Stochastic Environmental Research and Risk Assessment*, 1-3, doi:10.1007/s00477-008-0284-9, 2009, In Press.
48. **J.A. Vrugt**, B.A. Robinson, and J.M. Hyman, Self-adaptive multimethod search for global optimization in real parameter spaces, *IEEE Transactions on Evolutionary Computation*, 1-17, 10.1109/TEVC.2008.924428, 2009, In Press.
49. **J.A. Vrugt**, C.J.F. ter Braak, C.G.H. Diks, D. Higdon, B.A. Robinson, and J.M. Hyman, Accelerating Markov chain Monte Carlo simulation by differential evolution with self-adaptive randomized subspace sampling, *International Journal of Nonlinear Sciences and Numerical Simulation*, 2009, In Press.
50. P.H. Stauffer, **J.A. Vrugt**, H.J. Turin, C.W. Gable, and W.E. Soll, Untangling diffusion from advection in unsaturated porous media: Experimental data, modeling and parameter uncertainty assessment, *Vadose Zone Journal*, 2009, In Press.

Papers in Review

1. Y. Liu, T. Wagener, P. Young, and **J.A. Vrugt** with 20 other co-authors (in alphabetic order), Dynamic parameter identifiability analysis for hydrological and environmental model diagnostics and improvement, *Advances in Water Resources*, 2008.

2. K. Beven, J. Goetzinger, A. Montanari, and **J.A. Vrugt** with 20 other co-authors (in alphabetic order), How can we separate and identify input observation error versus model structural error?, *Advances in Water Resources*, 2008.
3. B. Jackson, B. Schaefli, H. Gupta, and **J.A. Vrugt** with 20 other co-authors (in alphabetic order), What is the information content of hydrologic data?, *Advances in Water Resources*, 2008.
4. A.W. Hinnell, T.P.A. Ferré, **J.A. Vrugt**, S. Moysey, J.A. Huisman, and M.B. Kowalsky, Improved extraction of hydrologic information from geophysical data through coupled hydrogeophysical inversion, *Water Resources Research*, 2008.

Papers in Preparation

1. **J.A. Vrugt**, C.J.F. ter Braak, and J.M. Hyman, Differential evolution adaptive Metropolis with sampling from past, *SIAM journal on Optimization*, 2008.
2. R. Elkington, S.C. Dekker, and **J.A. Vrugt**, Significant uncertainty of vegetation structure and properties from optimality of net carbon profit, *Ecohydrology*, 2008.
3. K.W. Blasch, T.P.A. Ferré, and **J.A. Vrugt**, Environmental controls on drainage behavior of an ephemeral stream: Beyond simple correlative data analysis, *Stochastic Environmental Research and Risk Assessment*, 2008.
4. J.A. Huisman, J. Rings, J, Sorg, **J.A. Vrugt**, and H. Vereecken, Coupled hydrogeophysical inversion to determine the hydraulic properties of a river dike, *Journal of Hydrology*, 2008.
5. J.H. Dane, **J.A. Vrugt**, and E. Unsal, AMALGAM optimization of equivalent capillary models of soils using observed air permeability data and high performance computing, *Physical Review Letters*, 2008.
6. E. Keating, J. Doherty, **J.A. Vrugt**, and Q. Kang, The applicability of calibration-constrained predictive uncertainty analysis techniques to strongly non-linear models with high parameter dimensionality, *Water Resources Research*, 2009.
7. D. Partridge, P. Tunved, A. Ekman, **J.A. Vrugt**, and A. Sorooshian, Determining sensitivity thresholds between aerosol size distribution and composition for cloud droplet parameters, *Atmospheric Chemistry and Physics*, 2009.
8. **J.A. Vrugt**, C.J.F. ter Braak, and J.M. Hyman, Distributed DREAM with sampling from past using multi-try Metropolis and parallel computing, *SIAM journal on Scientific Computing*, 2009.
9. N. Linde, and **J.A. Vrugt**, Probability density of spatially distributed soil moisture from travel time measurements of crosshole georadar, *Water Resources Research*, 2009.
10. B.A. Robinson, **J.A. Vrugt**, H. Yoon, C. J. Werth, O.A. Cirpka, and P.K. Kitanidis, Theory of diffusion into low permeability porous media needs to be revisited, *Proceedings of the National Academy of Sciences of the United States of America*, 2009.
11. M.T. van Wijk, and **J.A. Vrugt**, Significant tradeoff in the prediction of water and carbon fluxes from genetically adaptive model calibration, *Global Change Biology*, 2009.

Contributions in Books

1. **J.A. Vrugt**, H.V. Gupta, W. Bouten, and S. Sorooshian, A shuffled complex evolution Metropolis algorithm for estimating the posterior distribution of watershed model parameters, pp. 105-112 in Monograph on Advances in Automatic Calibration of Watershed Models, American Geophysical Union (Eds: Q. Duan, H.V. Gupta, S. Sorooshian, A.N. Rousseau, and R. Turcotte), 2002.
2. H.V. Gupta, L. Bastidas, **J.A. Vrugt**, and S. Sorooshian, Multiple criteria global optimization for watershed model calibration, pp. 125-132 in Monograph on Advances in Automatic Calibration of Watershed Models, American Geophysical Union (Eds: Q. Duan, H.V. Gupta, S. Sorooshian, A.N. Rousseau, and R. Turcotte), 2002.

3. **J.A. Vrugt**, and J.H. Dane, Inverse modeling of soil hydraulic properties, pp. 1003-1120 in Encyclopedia of Hydrological Sciences (Eds: M.G. Anderson, and J.J. McDonnell), John Wiley & Sons Ltd., Chichester, UK, 2005.
4. D.M. Higdon, C.S. Reese, J.D. Moulton, **J.A. Vrugt**, and C. Fox, Posterior exploration for computationally intensive forward models, pp. xx-xx in xxx (Eds: xxxxxx), Publisher Name, 2008.
5. K. Yilmaz, and **J.A. Vrugt**, Parameter exploration in watershed hydrology, pp. xx-xx in xxx (Eds: B. Sivakumar, and R. Berntson), Publisher Name, 2009.

Conference Proceedings

1. **J.A. Vrugt**, Merging the strengths of global optimization and data-assimilation to simultaneously estimate parameters and state variables in hydrologic models, Published in Proceedings of the ESF/LESC Exploratory Workshop on 'Hydrological risk: recent advances in peak river flow modeling, prediction and real time forecasting, Assessment of the impacts of land-use and climate change', Bologna, Italy, October, 23-25, 2003.
2. **J.A. Vrugt**, C.G.H. Diks, W. Bouten, and J.M. Verstraten, Improved treatment of uncertainty in hydrologic modeling, Proceedings of the British Hydrological Society International Conference, Volume 1, pp. 389-397, Imperial College, London, England, July, 2004.
3. **J.A. Vrugt**, Markov chain Monte Carlo sampling using multiple-chain differential evolution with adaptive proposal updating, Proceedings of the Fifth International Symposium on Environmental Hydraulics, Arizona State University, Tempe, 85281-6106, December, 2007.
4. Wöhling, Th., **Vrugt, J.A.**, Multiobjective inverse parameter estimation for modeling vadose zone water movement. MODSIM07 - International Congress on Modeling and Simulation. Land, Water & Environmental Management: Integrated Systems for Sustainability, Christchurch, New Zealand, December, 2007.

Presentations

Invited Talks

1. **J.A. Vrugt**, M*erging the strengths of global optimization and data-assimilation to simultaneously estimate parameters and state variables in hydrologic models*, Presented at the ESF/LESC Exploratory Workshop on Hydrological Risk: Recent Advances in Peak River Flow Modeling, Prediction and Real-time Forecasting, Assessment of the Impacts of Land-use and Climate Change, Bologna, Italy, October 23-25, 2003.
2. W. Bouten, and **J.A. Vrugt**, *Distributed modeling of catchments: Balancing modeling objectives, model complexity and data availability*, Presented at the General Assembly of the European Geophysical Union, Nice, France, April 25-30, 2004.
3. **J.A. Vrugt**, C.G.H. Diks, W. Bouten, and J.M. Verstraten, *Advanced parameter sampling strategies for environmental modeling*, Presented at 1st Meeting of the International Working Group on Uncertainty Analysis in Hydrologic Modeling, Lugano, Switzerland, July 5-8, 2004.
4. **J.A. Vrugt**, J.W. Hopmans, and P. Fisher, *Assessment of multi-dimensional root water uptake distributions: combining measuring and modeling*, Presented at University of Adelaide, Adelaide, Australia, August 16, 2004.
5. **J.A. Vrugt**, *Large scale spatially distributed vadose zone modeling using global optimization*, Presented at Subsurface Flow and Transport Modeling Team, Los Alamos National Laboratory, Los Alamos, 24 August, 2004.
6. **J.A. Vrugt**, *Multi-criteria optimization of long-distance bird migration: analyzing the trade-off between flight time and energy-use*, Presented at 2nd EuroBAM Network Meeting, Amsterdam, Netherlands, November 8, 2004.

7. **J.A. Vrugt**, *Calibration of finite element models using combined parameter and state estimation*, Presented at Workshop on Community Finite Element Models for Fault Systems and Tectonic Studies, Los Alamos, July 13, 2005.
8. **J.A. Vrugt**, *Hydrologic model calibration, Concepts, strategies and applications*, Presented at ISSAOS Summer School, L'Aquila, Italy, August 31, 2005.
9. **J.A. Vrugt**, *Hydrologic uncertainty assessment, Recursive calibration and data assimilation*, Presented at International Summer School on Atmospheric and Oceanic Sciences (ISSAOS), L'Aquila, Italy, September 1, 2005.
10. **J.A. Vrugt**, and B.A. Robinson, *Development of a hydrologic analysis framework for improved treatment of uncertainty*, Presented at American Geophysical Union Fall Meeting, San Francisco, December 5, 2005.
11. **J.A. Vrugt**, and B.A. Robinson, *Spatially distributed modeling of root water uptake using global optimization*, Presented at workshop on Modeling Vadose Zone Flow and Transport Processes in Radioactive Waste Management, Mol, Belgium, February 23, 2006.
12. **J.A. Vrugt**, and B.A. Robinson, *Multi-objective parameter and state estimation for improved analysis of multi-tracer experiments in subsurface media*, Presented at the General Assembly of the European Geophysical Union, Vienna, Austria, April 5, 2006.
13. **J.A. Vrugt**, *Uncertainty estimation in environmental models*, Presented at Department of Civil and Environmental Engineering, University of Trento, Trento, Italy, February 23, 2006.
14. **J.A. Vrugt**, *Development of a hydrologic analysis framework for improved treatment of uncertainty*, Presented at Earth and Environmental Sciences Division Review, Los Alamos, May 17, 2006.
15. **J.A. Vrugt**, *Ensemble prediction strategies in environmental modeling*, Presented at Workshop on Use of Long-range Hydrologic Forecasts for Reservoir Operations, Beijing, China, July 28, 2006.
16. **J.A. Vrugt**, *Confronting uncertainty in environmental modeling: Methods and applications*, Presented at Kickoff Workshop on Development, Assessment and Utilization of Complex Computer Models, Statistical and Applied Mathematical Sciences Institute (SAMSI), Durham, September 13, 2006.
17. **J.A. Vrugt**, *Confronting uncertainty in environmental modeling: Methods and applications*, Presented at the Swiss Federal Institute of Aquatic Science and Technology, Duebendorf, Switzerland, September 19, 2006.
18. **J.A. Vrugt**, *Uncertainty estimation in environmental modeling: from parameter to state estimation*, Presented at the University of Amsterdam, Amsterdam, The Netherlands, May 7, 2007.
19. **J.A. Vrugt**, *Improved model calibration from genetically adaptive multimethod search*, Presented at AAPG Hedberg Conference on Basin Modeling Perspectives: Innovative Developments and Novel Applications, The Hague, The Netherlands, May 9, 2007.
20. **J.A. Vrugt**, *AMALGAM: A general-purpose multimethod evolutionary search algorithm for inverse modeling*, Presented at the Department of Geophysics, Stanford University, Stanford, June 6, 2007.
21. **J.A. Vrugt**, *Self-adaptive multimethod optimization, and Bayesian model averaging for calibration and uncertainty estimation*, Presented at Chevron, San Ramon, October 9, 2007.
22. **J.A. Vrugt**, *Self-adaptive Markov chain Monte Carlo simulation: methodological development and applications*, Presented at Fifth International Symposium on Environmental Hydraulics, Arizona State University, Phoenix, December 6, 2007.
23. **J.A. Vrugt**, and T. Wöhling, *Upscaling soil hydraulic properties using field-scale inverse modeling and Bayesian model averaging*, Presented at American Geophysical Union Fall Meeting, San Francisco, December 10-14, 2007.

24. **J.A. Vrugt**, *Improved treatment of uncertainty in hydrologic modeling*, Presented at Department of Civil and Environmental Engineering, University of California Berkeley, Berkeley, February 25, 2008.
25. **J.A. Vrugt**, *Treatment of hydrologic parameter uncertainty using Markov chain Monte Carlo sampling and high performance computing*, Presented at Department of Hydrology and Water Resources, The University of Arizona, Tucson, March 12, 2008.
26. **J.A. Vrugt**, *Adaptive Markov chain Monte Carlo sampling for estimating parameters in high-resolution three-dimensional flow and transport models*, Presented at New Mexico Institute of Technology, Socorro, March 24, 2008.
27. **J.A. Vrugt**, *Adaptive Markov Chain Monte Carlo Sampling and High Performance Computing for Estimating Parameters in High-Resolution Three-Dimensional Flow and Transport Models*, Presented at Computational Methods in Water Resources, XVII International Conference, San Francisco, July 6-10, 2008.
28. **J.A. Vrugt**, *Inverse Modeling to Improve Environmental Models*, To be presented at Institute of Biodiversity and Ecosystem Dynamics (IBED), University of Amsterdam, Amsterdam, November 13, 2008.
29. **J.A. Vrugt**, *Treatment of rainfall error using Markov chain Monte Carlo simulation*, To be presented at National Severe Storms Laboratory, National Weather Center (NWC), Oklahoma, October, 2008.
30. **J.A. Vrugt**, *Treatment of rainfall error using Markov chain Monte Carlo simulation*, To be presented at Annual Meeting of the American Meteorological Society (AMS), Phoenix, January 11-15, 2009.
31. **J.A. Vrugt**, *Uncertainty Estimation Using Adaptive Markov Chain Monte Carlo Simulation and Particle Filtering*, To be presented at SIAM Conference on Computational Science and Engineering (CSE09), Miami, March 2-6, 2009.
32. **J.A. Vrugt**, *Transforming Data into Models Using Bayesian Statistics and Sampling*, To be presented at General Assembly of the European Geophysical Union, Vienna, April 19-24, 2009.
33. **J.A. Vrugt**, *Self Adaptive Learning in Global Optimization and Filtering*, To be presented at the first PEST users conference, Washington DC, November 2-4, 2009.

Other Talks

1. **J.A. Vrugt**, and W. Bouten, Is the best fit to experimental data what we are really looking for? Presented at the International Study Group on Inverse Modeling (ISGIM), Orange Coast, AL, USA, November 1-3, 2000.
2. **J.A. Vrugt**, J.W. Hopmans, and J. Simunek, Application of one, two and three-dimensional root water uptake in transient flow modeling, Presented at the International Study Group on Inverse Modeling (ISGIM), Orange Coast, AL, USA, November 1-3, 2000.
3. **J.A. Vrugt**, H.V. Gupta, W. Bouten, and S. Sorooshian, A Shuffled Complex Evolution Metropolis algorithm for optimization and uncertainty assessment of hydrological model parameters, Presented at the AGU fall meeting, San Francisco, CA, USA, December 6-10, 2002.
4. **J.A. Vrugt**, H.V. Gupta, W. Bouten, and S. Sorooshian, Confronting uncertainty in hydrologic modeling, Presented at the International Study Group on Inverse Modeling (ISGIM), Thurnau, Germany, April 3-5, 2003.
5. **J.A. Vrugt**, H.V. Gupta, W. Bouten, and S. Sorooshian, A Shuffled Complex Evolution Metropolis algorithm for confronting parameter uncertainty in hydrologic modeling, Presented at the General Assembly of the European Geophysical Society, Nice, France, April 6-11, 2003.

6. **J.A. Vrugt**, G.H. Schoups, J.W. Hopmans, C.A. Young, W.W. Wallender, T. Harter, and W. Bouten, Identification of Spatially Distributed Soil Hydraulic Properties in Hydrologic Modeling Using Global Optimization, Presented at the AGU fall meeting, San Francisco, CA, USA, December 8-12, 2003.
7. **J.A. Vrugt**, C.G.H. Diks, W. Bouten, H.V. Gupta, and J.M. Verstraten, Towards a complete treatment of uncertainty in hydrologic modeling: Combining the strengths of global optimization and data assimilation, Presented at the 7th Netherlands Earth Sciences conference, April 5-6, Veldhoven, 2004.
8. **J.A. Vrugt**, Improved treatment of uncertainty in hydrologic modeling, Presented at the British Hydrological Society International Conference on Hydrology: Science & Practice for the 21st Century, Imperial College, London, England, July 12-16, 2004.
9. **J.A. Vrugt**, C.G.H. Diks, W. Bouten, H.V. Gupta, and J.M. Verstraten, Improved treatment of uncertainty in hydrologic modeling: combining the strengths of global optimization and data assimilation, Presented at the General Assembly of the European Geophysical Union, Nice, France, April 25-30, 2004.
10. **J.A. Vrugt**, and H.V. Gupta, Real-time data assimilation for operational ensemble streamflow forecasting, Presented at the 2nd HEPEX workshop, Boulder, CO, USA, July 19-22, 2006.
11. **J.A. Vrugt**, Improved treatment of uncertainty in hydrologic modeling, Presented at the New Mexico water resources symposium, Socorro, NM, USA, August 16, 2005.
12. **J.A. Vrugt**, and B.A. Robinson, On the value of sequential data assimilation and Bayesian model averaging for probabilistic ensemble streamflow forecasting, Presented at the Western Pacific Geophysics Meeting, Beijing, China, July 23-27, 2006.
13. **J.A. Vrugt**, and B.A Robinson, Improved interpretation of multi-tracer experiments in subsurface media: multi-objective parameter and state estimation, Presented at the 2006 international annual meeting of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Indianapolis, IN, USA, Nov 12-16, 2006.
14. **J.A. Vrugt**, and B.A Robinson, Improved evolutionary optimization from genetically adaptive multi-method search, Presented at the AGU fall meeting, San Francisco, CA, USA, December 10-15, 2006.
15. **J.A. Vrugt**, Self-adaptive multimethod search for improved calibration of hydrologic models, Presented at the Water Research Symposium, Socorro, NM, USA, August 14, 2007.
16. **J.A. Vrugt**, Inverse modeling of subsurface flow and transport parameters using recent advances in global optimization and parallel computing, Presented at the Unsaturated Zone Interest Group (UZIG) meeting, Los Alamos, NM, USA, August 27-30, 2007.
17. **J.A. Vrugt**, A universal multimethod search strategy for computationally efficient global optimization, Presented at the Geological Society of America Annual Meeting, Denver, CO, USA, October 28-31, 2007.
18. **J.A. Vrugt**, B.A. Robinson, and J.M. Hyman, Self-adaptive multimethod search for global optimization of hydrologic model parameters, Presented at the General Assembly of the European Geophysical Union, Nice, France, April 13-18, 2008.
19. **J.A. Vrugt**, C.J.F. ter Braak, M.P. Clark, J.M. Hyman, and B.A. Robinson, Bayesian treatment of forcing error using adaptive Markov chain Monte Carlo sampling, Presented at the General Assembly of the European Geophysical Union, Nice, France, April 13-18, 2008.

Posters

1. T. Wagener, **J.A. Vrugt**, H.S. Wheater, H.V. Gupta, and S. Sorooshian, A dynamic approach to the identification of conceptual hydrological models, AGU fall meeting, San Francisco, CA, USA, December 6-10, 2002.
2. **J.A. Vrugt**, G.H. Schoups, J.W. Hopmans, C.A. Young, W.W. Wallender, T. Harter, and W. Bouten, Inverse modeling of large-scale spatially distributed vadose zone properties using global optimization, General Assembly of the European Geophysical Union, Nice, France, April 25-30, 2004.
3. J.W. Hopmans, G.H. Schoups, **J.A. Vrugt**, C. Young, T. Harter, and W.W. Wallender, Parameter identification of large-scale spatially distributed vadose zone properties using global optimization, Gordon Conference on Flow and Transport in Porous Media, Oxford, England, July 11-16, 2004.
4. **J.A. Vrugt**, H.V. Gupta, B. Nuallin, H.V. Gupta, and W. Bouten, Real-time data assimilation for operational ensemble streamflow forecasting, EGU meeting, Vienna, April 2005.
5. P.H. Stauffer, and **J.A. Vrugt**, The unsaturated zone transport test, Busted Butte, NV: Phase 1B: Experimental results and model validation Unsaturated Zone Interest Group (UZIG) meeting, Los Alamos, NM, USA, August 27 - 30, 2007.
6. T.P.A. Ferré, **J.A. Vrugt**, and A.C. Hinnell, Hydrogeophysical estimation of soil hydraulic properties during one-step outflow, AGU fall meeting, San Francisco, December, 2007.

Computer/ Programming Skills

Excellent in MATLAB/OCTAVE, proficient in Fortran, Unix/shell script programming, LaTeX, MPI, parallel computing, and all aspects of Windows platform (Word, PowerPoint, Excel, WordPerfect). Familiar with GIS software and C programming.

Language Skills

Dutch (native), English (fluent), German (fluent), Farsi (Basic), French (Basic).